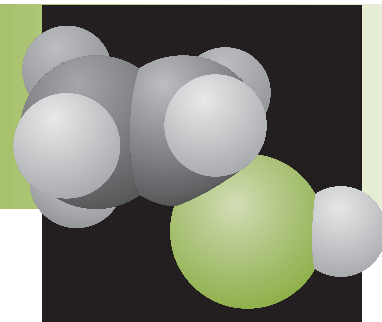


CHEMICALS

Project Fact Sheet



NEW ELECTROCHEMICAL REACTORS COULD SIGNIFICANTLY CUT U.S. ELECTRIC POWER CONSUMPTION AND POWER PLANT EMISSIONS

BENEFITS

- Energy savings of 95 trillion Btu per year
- Operational cost savings with installation of new ECR process
- Decreased carbon emissions

APPLICATIONS

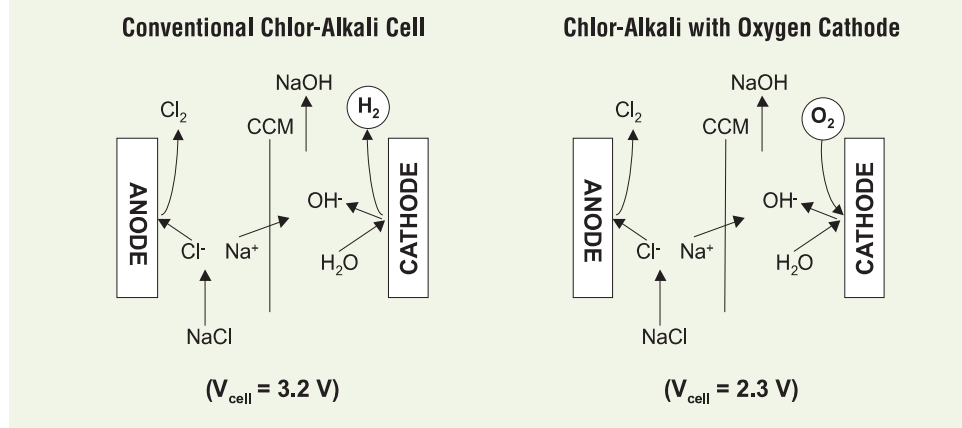
The improved oxygen cathode technology will have a significant impact on the chlor-alkali industry as operating costs continue to be affected by the increased cost of energy and emission controls. To compete globally in this industry and to conform to possible future regulations, U.S. chemical companies require the development of energy-efficient electrochemical technology.

ENERGY EFFICIENT REACTORS COULD CUT U.S. ELECTRIC POWER CONSUMPTION BY UP TO 0.6 PERCENT

Existing chlor-alkali electrochemical reactors consume approximately 2 percent of the total electric power generated in the United States. The proposed new electrochemical reactor (ECR) would reduce the cell power consumed by the chlor-alkali industry per unit weight of chlorine or caustic product. Energy consumed per unit weight of those products is directly proportional to cell voltage. Lowering of the chlor-alkali cell voltage is the route to energy savings and will be accomplished by replacing the hydrogen-evolving cathode in such cells with an oxygen-consuming cathode. The resulting 30 percent savings in electric power equates to 95 trillion Btu in energy savings.

Future market forces may cause energy prices to rise from their present historic lows. Government regulations both here and abroad may exacerbate this trend. The proposed system will potentially reduce chlor-alkali producers' exposure to rising energy prices, enabling conservation of precious energy resources and reduction of undesirable power plant emissions by 2020.

ENERGY CONSUMPTION REDUCTION USING A CHLOR-ALKALI ECR



Comparison of conventional and advanced chlor-alkali cells. Both cells use a non-permeable cation conducting membrane (CCM) to separate aqueous NaCl anolyte from the NaOH catholyte. Oxygen is consumed by the cathode of the advanced cell, reducing the cell voltage by 0.9V.



Project Description

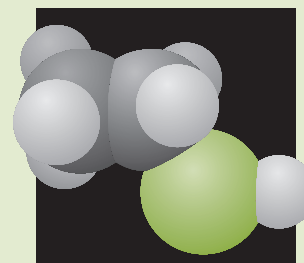
Goal: Develop chlor-alkali electrochemical reactors to reduce energy consumption by up to 30 percent with a potential subsequent reduction in plant operating costs.

The proposed process replaces the hydrogen-evolving cathode with an oxygen-consuming cathode and reduces the electrochemical cell voltage. The oxygen cathode is a gas diffusion electrode. The oxygen cathode structure must satisfy two conflicting criteria, high gas permeability and low liquid permeability, in order to achieve the high performance required for commercial production. Maintaining a stable interface between liquid and gas within the active electrode is the key to long-term operation.

The work proposed for the project in the areas of cell fabrication and testing consists of completing development of effective oxygen cathodes and demonstrating stable performance in laboratory-scale, chlor-alkali cells; implementing an oxygen cathode in a pre-pilot cell; and implementing and testing oxygen electrodes in a pilot plant. In concert with the development program, a techno-economic study will be conducted to determine the commercial potential of the technology.

Progress and Milestones

- Researchers have adapted an advanced oxygen cathode to a chlor-alkali ECR.
- A patent application was submitted in May 1996.
- The oxygen cathode cells ran with current efficiencies of 96 to 98 percent, which equals or exceeds efficiencies in chlor-alkali ECRs with hydrogen-evolving cathodes.
- In progress are plans to identify an oxygen cathode of high and stable catalytic activity, define membrane parameters, and conduct pilot scale testing.
- A first milestone will be one week of stable cell operation at 0.9V voltage savings using the best developed cathode catalyst and cathode substrate material and structure.
- Other anticipated milestones are extending the demonstrated life of the laboratory cells beyond six months with potential savings of 0.9V for the cathode, potential cathode decay of 0.005V/month or less, and current efficiency greater than 95 percent.
- Private industry is expected to further develop this process upon successful completion of pre-pilot cell trials.



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